

Notes

Temporary breeding populations of *Phoebis sennae eubule* (L.) (Lepidoptera: Pieridae) in Ohio and West Virginia

The cloudless sulphur, *Phoebis sennae* (L.) is primarily a tropical and subtropical butterfly. In eastern North America, the subspecies *P. s. eubule* (L.) is a permanent resident generally south of North Carolina, Tennessee and Arkansas. The species regularly emigrates northward in late summer and early autumn, occasionally reaching southern Canada (Opler and Krizek, 1984; Scott, 1987). Northward, the species occurs in the Mississippi Valley to central Illinois (Irwin and Downey, 1973) and along the Atlantic Coastal Plain to New Jersey (Stone, 1903; Shapiro, 1966). In these areas, it is known to reproduce as far north as west-central Illinois (Sedman and Hess, 1985) and Virginia (Clark and Clark, 1951). Northern breeding records of *P. s. eubule* from outside the Mississippi Valley and Atlantic Coastal Plain are virtually nonexistent.

In 1987, much of the eastern United States witnessed a large and previously unsurpassed flight of *P. s. eubule*. Numbers were observed as far north as Wisconsin and New York. It was common in portions of Missouri, Illinois and Kentucky and frequently encountered in Indiana, Ohio and West Virginia. The species was unusually common even in the extreme southeastern states where it is a permanent resident.

In Ohio, historical records of *P. s. eubule* were limited to only eight counties following over 130 years of collecting. During the exceptional flight of 1987, the species was recorded in 15 additional counties and observed in at least eight others. In West Virginia, *P. s. eubule* was recorded in seven counties, representing the first records in the state. Individuals were observed and captured as early as April and May in this region. Prior to 1987, the earliest date of capture in Ohio was 29 July (1931).

Several temporary breeding populations of *P. s. eubule* were found in Ohio and West Virginia in 1987. Many of these populations were located directly adjacent to rivers and streams. Valleys of rivers and major streams appear to serve as primary corridors of dispersal for this species in the region. A riparian affinity has also been noted in Illinois (Sedman and Hess, 1985). In West Virginia, *P. s. eubule* was observed at the summit of Cheat Mountain (approx. 1140 m.), thus it is possible that the species also follows mountain ridgetops.

Two color forms of *P. s. eubule* larvae were found and reared on wild senna (*Cassia hebecarpa* Fern.) and partridge-pea (*Cassia fasciculata* Michx.). Where the butterfly utilized wild senna in Ohio, green larvae were found feeding on both the leaves and yellow flowers of the plants. Conversely, yellow larvae were nearly always found feeding on the flowers. Because of these color associations, even large mature larvae were inconspicuous. Pupal periods of the species in Ohio and West Virginia ranged from five to nine days, in contrast to the reported pupal periods of *P. s. eubule* in Georgia (10–12 days) (Scudder, 1889) and *P. s. marcellina* in Brazil (nine–13 days) (Brown and Heineman, 1972). The finding may suggest that development is more rapid where the species is not a permanent resident.

At least two broods of *P. s. eubule* were produced in Ohio and West Virginia in

1987. The populations persisted until the hostplants began to dry in late summer. Adults, especially males, continued to be observed into late September. No southward autumn migration was reported, though such an occurrence was noted in Tennessee in September (L. Martin, pers. comm.). Because the flight of *P. s. eubule* is typically rapid and unflagging, many more individuals were observed than collected. However, males are strongly attracted to bright yellow objects and many were captured using decoys of yellow paper and dried specimens of the species.

Exactly what caused this unprecedented explosion of *P. s. eubule* is unknown. Surely, no single factor can be attributed, but climatic conditions probably played a major role. In much of the east, the winter of 1986–87 was mild and followed by an early spring. This may have allowed *P. s. eubule* to begin reproducing and emigrating prematurely, thereby reaching northern areas early in the season and establishing breeding populations. An early arrival in the north may also have been augmented by overwintering individuals. If *P. s. eubule* adults have the ability to overwinter, as suggested by Scudder (1889), it could have survived far to the north of its permanent range during the mild winter of 1986–87. These factors alone, however, do not explain the overall abundance throughout much of the east.

It was also noted in 1987 that the hostplants, especially partridge-pea, experienced a very productive year in Kentucky, Ohio and West Virginia. If the situation was widespread in the east, it could have provided the necessary catalyst for the rapid spread and increased productivity of *P. s. eubule* in this portion of the country. An abundance of partridge-pea was observed in connection with a local outbreak of *P. s. eubule* in Kansas in 1987 (Howe, 1987).

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Thanatosis in the Neotropical Butterfly *Caligo illioneus* (Nymphalidae: Brassoliniæ)

During the course of studies on flight kinematics in Neotropical butterflies, thanatosis (death-feigning behavior) was noticed in a female *Caligo illioneus*. The following observations were made in July 1987 in a small screened insectary on Barro Colorado Island, Republic of Panama. Mass of the insect was 1.84 g, the ambient air temperature was 27°C, and the relative humidity 88%. Ambient air motions in the insectary were negligible. Observations began with the butterfly at rest on an insectary wall with the wings folded together dorsally. When grasped by the base of the folded forewings and removed from the wall, the butterfly entered a thanatonic condition, characterized by complete absence of wing or leg motion, with the legs tucked against the body as in flight. When then placed upon (and with wings parallel to) a horizontal surface, the insect remained motionless. While in this condition, tactile stimulation of the wings, legs and body produced no behavioral response. Eventually the insect righted itself and flew away; in eight consecutive trials each separated by several minutes, the mean time to self-righting was 55 seconds (s.d. = 49 s). Dropping the thanatonic insect upside-down from a height of several meters resulted in a short vertical drop followed by wing-spreading and active flapping flight or gliding to the walls of the insectary.

Thanatosis has been observed in a variety of animals, including numerous beetles (Bleich, 1928), mantids (Edmunds, 1972), moths (Blest, 1964), snakes (Gehlbach, 1970; see also Greene, 1988) and mammals (e.g. Francq, 1969; Ewer, 1966). It has been suggested that thanatosis induces relaxation of predator attention, possibly allowing for active escape of the prey during the handling phase of a predatory event (Ratner & Thompson, 1960). Butterflies are frequently attacked by insectivorous birds. Chai (1986) reported that the jacamar *Galbula ruficauda*, a specialized avian predator of flying insects, required on average 9 minutes (maximally 40 minutes) to strip large butterflies of their wings prior to consumption of the body. Wing-stripping by jacamars occurs upon the cessation of struggle by the butterfly. If thanatosis on the part of butterflies does induce momentary inattention during the wing-stripping procedure, possibilities for escape are heightened. Additionally, death-feigning may be an advantageous defense, following an initial unsuccessful attack, against predators which only attack moving prey. Curiously, thanatosis involves an inhibition of wing flapping concurrent with an absence